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# Subject-specific Musculoskeletal Simulation of Hip Dislocation Risk in Activities of Daily Living

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## Initiating problem

Risk of dislocation in THR patients during activities of daily living, for instance car ingress/egress.

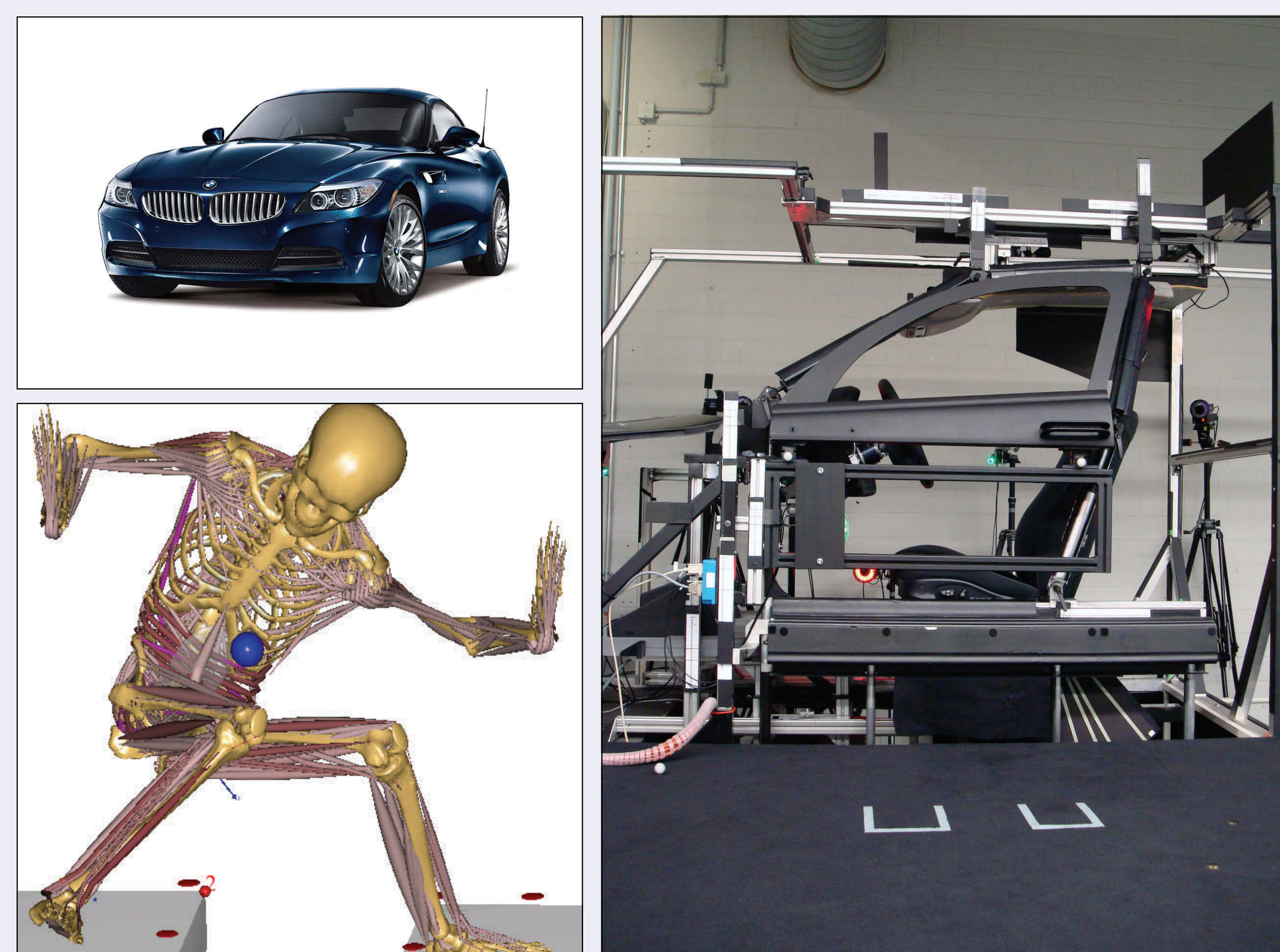
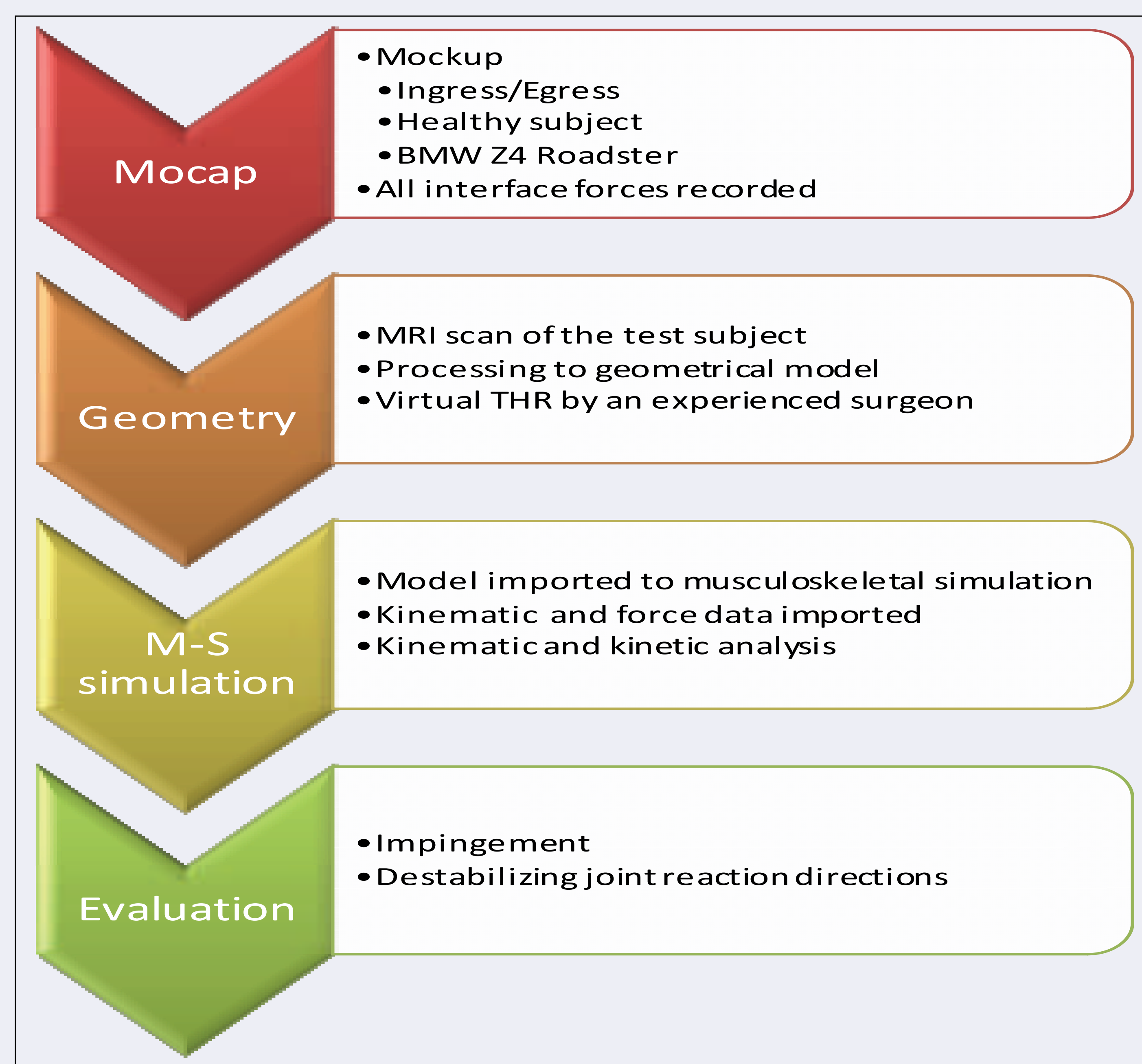
## Possible causes

- Impingement may dislocate the joint via a crowbar effect. Impingement is also correlated to pain, increased wear and early revision.
- Joint reactions pointing out of the acetabulum may dislocate the joint.

## Technology

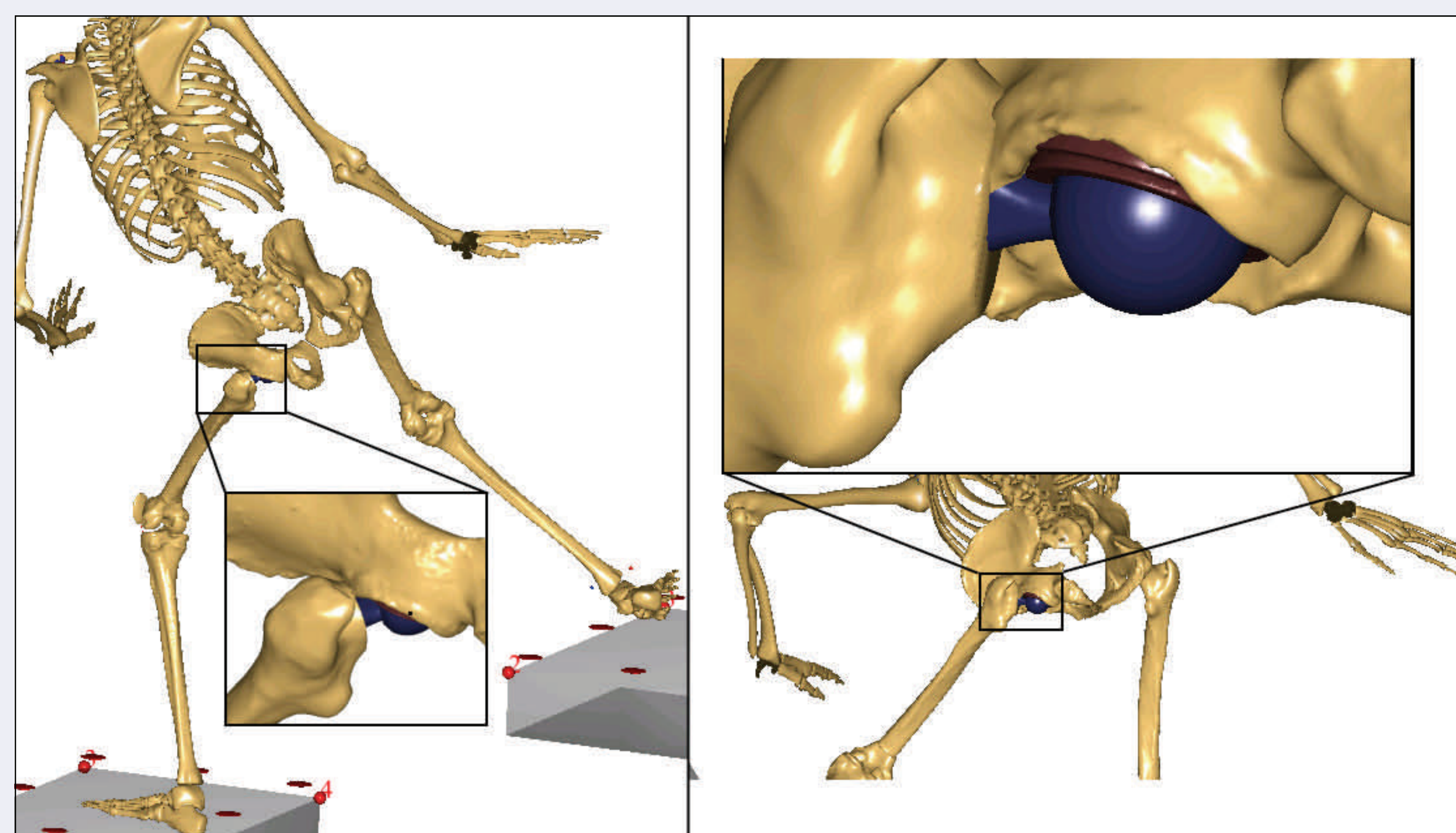
- Mockup of a BMW Z4 Roadster allowing for line-of-sight for cameras.
- Basler camera system with Kistler force platforms and Simi Motion software.
- MRI scan performed at Medizinisches Versorgungszentrum (Regensburg, Germany)
- Segmentation of MRI data, 3D model reconstruction and virtual implantation of 32 mm THR performed with Mimics, Materialise, Leuven, Belgium.
- Kinematic processing and musculoskeletal analysis by the AnyBody Modeling System, AnyBody Technology, Aalborg, Denmark.

## Methods



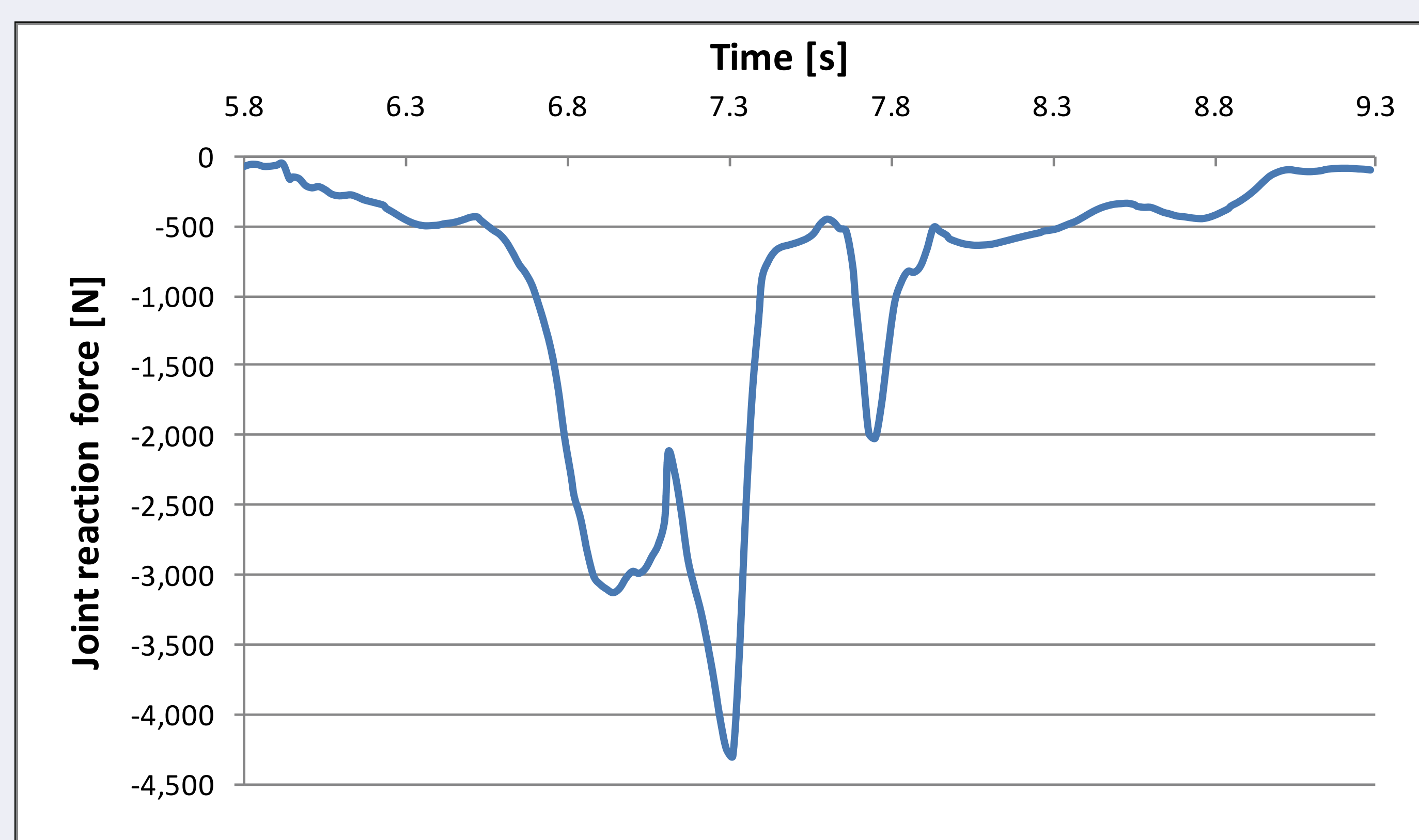
BMW Z4 Roadster, Experimental Mockup and Musculoskeletal Model.

## Kinematic results



(Muscles omitted for clarity): Two of several detected cases of impingement. Left: Collision between the sectioned surface of the femur and the rim of the acetabulum. Right: Collision between the neck of the prosthesis and the rim of the cup.

## Kinetic results



Simulated hip joint reaction force projected to the direction perpendicular to the surface spanned by the cup rim. Negative values are stable, so no instability due to joint reaction forces is detected.

## Conclusions

- The recorded movement for a healthy individual will lead to **risk of dislocation due to impingement** for a THR patient.
- The kinetic analysis detects **no dislocation due to net joint forces**.
- The combination of motion analysis of activities of daily living and detailed musculoskeletal models can be used to assess dislocation risks and design implants and implantation variables to minimize the risk.

**Systematic simulation of activities of daily living in combination with design and implantation parameter variations may lead to implants less susceptible to dislocation.**

## Poster # 0306

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